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ABSTRACT

A study was conducted to determine the relative effectiveness of several different visual, visual-verbal, and verbal treatments on the recall of factual information. The primary measure of individual differences of subjects involved in the study was that of intelligence quotient (I.Q.). The study attempted to determine whether or not treatments might be differentially designed in order that individual differences of this nature might be adequately accommodated. The subjects, 319 senior high school students, were divided into six treatment groups which were matched as nearly as possible on the variables of sex and age; each of these three groups was further subdivided into three I.Q. groups in order to analyze performance relative to intelligence. Information was presented in formats ranging from visual only through various visual-verbal treatments to one that was verbal only. Subjects were then tested for recall. Analysis of test results suggests that no single treatment was more effective for a given I.Q. group than was any other treatment and that high fidelity, full color visual-verbal presentation of information is the most effective of all the methods of presentation tested. A short list of references is appended. (JY)

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VARIATION OF INFORMATION PRESENTATION AS A METHOD OF ACCOMMODATING INDIVIDUAL DIFFERENCES

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This study was conducted in an effort to determine the relative effectiveness of several different visual, visual-verbal, and verbal treatments on the recall of factual information. The information to be recalled was either displayed, displayed and described, or described in the various treatment presentations. Amount of recall was the principal criterion for assessing the effectiveness of the treatment.

The primary measure of individual differences of subjects involved in the study was that of intelligence quotient. The study was directed toward determining whether or not treatments might be differentially designed in order that individual differences of this nature might be adequately accommodated.

Additionally, an effort was made to assess the relationship between the intelligence of the subject and his ability to solve verbally posited problems through visual means.

The population for this study consisted of 319 senior high school students from two schools in the Granite School District in Utah. The total subject group was divided into six treatment groups which were matched as nearly as possible on the variables of sex and age; other variables such as socioeconomic status and ethnic group membership were not considered. Each of the six treatment groups was further subdivided into three I.Q. groups in order that an analysis of performance relative to recall/intelligence might be conducted.

A modified "realism continuum" served as the basic model for the design of the various treatments but no attempt was made to fill every niche in the hierarchy of treatments in the complete continuum. Essentially, the treatments ranged from a visual only format through various visual-verbal formats to one that was verbal only.

Treatment one included a set of full-color paintings of five different imaginary animals complete with environment and food but without congruent verbal description. Treatment

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two involved the same set of visuals as did treatment one but included a congruent verbal description of the animals, their habitat, food, method of acquiring food, and protective adaptations. Treatment three involved the same verbal description as treatment two, but the five animals were rendered in black and white half-tone form on a neutral ground which included no indication of food or habitat. Treatment four employed the same verbal presentation as did treatments two and three, but in this series, the five animals were rendered in simple black and white cartoon fashion with the referred-to attributes of the animal exaggerated. Treatment five, once again, employed the common verbal tape but the visuals were rendered as simple outline "compressed" drawings which lacked color and form as well as detail. Treatment six consisted of a verbal description of the five animals with no accompanying visuals---this constituted the verbal only treatment. All treatments were presented to the subjects for an equivalent amount of time.

The five animals were assigned names that were considered to be somewhat meaningful, yet not descriptive to the extent that they would reveal essential cues and therefore introduce an additional variable into the study. Numbers were also used in conjunction with the names as an additional identifying device. Nonsense labels were considered but were rejected because it was felt that to require the subject to memorize a new term as an identification device would simply add to the confusion of attempting to correctly identify one specific animal from an array of animals.

The names assigned were as follows: Animal Number One, The Large-Eyed Snapper; Animal Number Two, The Swift Roamer; Animal Number Three, The Greater Wanderer; Animal Number Four, the Lesser Searcher; Animal Number Five, The Small-Eared Plodder.

The utilization of the imaginary animal and environment was an attempt to accomplish three things. The first consideration involved the attempt to preclude as much prior learning as possible, thereby starting all subjects at a more equivalent point. Second was the effort to replicate typical classroom materials and presentation strategies. Third was the attempt to incorporate the factor of student interest and arousal in the design of the unique, perhaps grotesque, imaginary creatures. The degree to which these efforts were realized has not been thoroughly measured at this time, however, observations made of the subjects in the act of responding to the visuals would indicate that the arousal factor consideration was a valid one.

The original renderings of the animals were photographed on 35mm Ektachrome slides and were then grouped into treatments which were based on the degree of simplification of the creatures. The five resultant slide sets were then presented to the six subject groups with appropriate concurrent verbal presentations where indicated. Treatment number six was verbal only and was not accompanied by visuals. All visuals included printed name captions and the number of the animal in large, black Roman style letters on a rectangular white ground.

An objective test instrument was administered to the subjects immediately at the conclusion of the presentations to test for recall of data shown and/or described. The same test was again administered after a two-week period to test for extended recall.

After the subjects had been exposed to the specific animal set and after the immediate post-test had been given, a second test instrument was employed. This instrument was verbal in nature and called for a visual response. It was designed with the intent of eliciting responses which would be based more on reasoning ability and imagination than on recall of factual material. The instrument described a hypothetical environment which was highly hostile to typical life-forms. The subject was required to create, visually in a space provided, an imaginary creature capable of surviving this environment.

The responses to this test were judged on the basis of uniqueness and appropriateness of response on a continuum which ranged from poor through superior. The judges were three graduate students who were specifically trained for this operation. Experts in the area of creativity and visual design were initially contacted in an effort to recruit the most satisfactory panel of judges. However, strong convictions and orientations made the experts less amenable to training than the group ultimately selected as the panel. The interjudge reliability of the judges was found to be acceptable through the use of statistical procedures (Table 1).

The judgments were assigned numerical equivalents and the results tabulated. The resultant scores were correlated with subject I.Q.s in an effort to determine whether or not a correlation did exist between intelligence as measured by standardized tests and the ability to creatively solve problems in other than verbal terms. No attempt was made by the judges to assess the artistic quality of the responses; success on this test was based strictly on the uniqueness and appropriateness of the response.

TABLE 1
INTERJUDGE RELIABILITY OF THE THREE
DRAWING TEST JUDGES

	Judge 1	Judge 2	Judge 3
Judge 1	1.00		
Judge 2	.60	1.00	
Judge 3	.71	.66	1.00

An analysis was conducted of the overall objective scores on questions specifically related to food, the questions specifically related to environment, and the questions specifically related to color. Comparisons were made between the subject's performance and the treatment to which he was exposed. An effort was made to determine whether or not actually displaying a cue--such as food--was significantly better than merely describing it.

A two-way analysis of variance with repeated measures was computed in order that the interactions between the different variables might be determined. Correlations were also computed so that the relationships between other related measures might be assessed. The statistical design of this study was one of repeated measures on subjects in a $6 \times 3 \times 2 \times 4$ factorial design (six treatments \times three I.Q. subgroups \times two periods of testing \times four measures) (Table 2).

Findings

The prediction that the ability of a subject to visually solve a problem in verbal terms (with the emphasis on creativeness of response) would not be significantly correlated with I.Q. was substantiated (Table 3).

A significant difference ($p = <.01$) was found to exist between the six treatment groups across all eight measures (food, environment, color, other attributes, immediate and delayed post-tests). The mean for treatment number six, the verbal only treatment, was lower by 3.141 points

TABLE 2
SUMMARY OF ANALYSIS OF VARIANCE, N = 180

Source of Variation	Sum of Squares	df	Mean Square	F	P
A Among treatment groups	1411.289	5	288.258	11.315	.01
B Among I.Q. groups	1380.838	2	690.419	27.100	.01
AB	130.753	10	13.075	<u>a/</u>	NS
(Error)	4127.297	162	25.477		
C Periods of testing	1596.011	1	1596.011	232.012	.01
D Measures	134684.955	3	44894.985	6526.382	.01
CD	2077.898	3	692.633	100.688	.01
AC	237.581	5	47.516	6.907	.01
AD	1889.176	15	125.945	18.309	.01
BC	1.173	2	.587	<u>a/</u>	NS
BD	2129.309	6	354.885	51.590	.01
BCD	5.602	6	.934	<u>a/</u>	NS
ABC	125.635	10	12.564	1.826	NS
ABD	222.564	30	7.419	1.078	NS
ABCD	205.969	30	6.866	<u>a/</u>	NS
(Error)	7800.912	113	6.879		

a/ F ratio less than one.

TABLE 3
CORRELATION COEFFICIENTS BETWEEN I.Q.
AND CREATIVE VISUAL RESPONSE

Judge 1	Judge 2	Judge 3
.13	.11	.14

(Significance would begin at .15)

than the mean which was derived from treatment number two, the high fidelity visual-verbal treatment (treatment two mean = 11.008; treatment six mean = 7.867).

The difference between the total means based on the six treatments was found to be significant for the three I.Q. groups ($p = < .01$). This finding supported the hypothesis that a positive correlation would be found between the retention of factual information and the I.Q. level of the subject.

The interaction between I.Q. and treatment groups is shown in Table 4. The mean for treatment two, the high fidelity visual-verbal, is higher for the students in I.Q. group one than is the mean for any other treatment. The subjects in I.Q. group two (the medium group) scored higher on treatment four, the black and white cartoon treatment, than they did on any other treatment. When I.Q. group three (the low I.Q. group) is considered, the high fidelity visual-verbal treatment two once again produced the higher mean. Although obvious differences are to be seen between the means listed in Table 4, the analysis of variance failed to indicate statistical significance between the treatment means by I.Q. groups. This finding would suggest that no single treatment was more effective for a given I.Q. group than was any other treatment (at the .01 or .05 levels).

It was postulated that the high fidelity, full color visual-verbal treatment would produce higher scores on the questions specifically related to color than would any of the other treatments. This hypothesis was substantiated ($p = < .01$).

It was also found that students who were exposed to the high fidelity, full color visual-verbal treatment where the attributes of food and environment were displayed scored

TABLE 4
MEANS FOR TREATMENT GROUP BY I.Q. CATEGORIES

Treatment Group	I. Q. Groups		
	High	Medium	Low
1	10.45000	9.67500	7.71250
2	12.20000	10.56250	10.26250
3	11.28750	10.06250	9.06250
4	11.22500	10.86250	8.78750
5	10.63750	8.90000	8.08750
6	8.85000	8.36250	6.38750

significantly higher ($p = <.01$) on questions specifically related to these attributes than did students who were exposed to the other treatments.

It was postulated that because the nature of the stimulus materials used in this study was so very visual, the verbal only treatment would produce lower test scores throughout all I.Q. ranges than would the other treatments. Significance ($p = <.01$) was found to exist relative to this hypothesis.

The difference in the combined means between the immediate post-test and the delayed post-test was found to be significant at the .01 level.

The hypothesis that delayed recall would be greater for the upper I.Q. students involved in treatment two than for those involved in treatments other than two was not substantiated.

The hypothesis that delayed recall for all visual-verbal treatments would be greater than for either the visual only or verbal only treatments was only partially substantiated. Although treatment six, the verbal only treatment was lower than all visual-verbal treatments, treatment one, the visual only treatment was not. The mean for treatment one was greater than the mean for treatment five (the compressed black and white outline treatment with verbal).

Recommendations

Although much research remains to be carried out before the design of visual materials can become scientific to the point that predictable outcomes can be assured when a specific visual teaching strategy is undertaken, the findings resulting from the current study indicate that within the delimitations established for the study, certain results can be predicted. The following recommendations are made on the basis of these findings:

1. It is recommended that alternate methods of testing be utilized as an adjunct or alternative to the traditional tests where this is possible. Final "papers" in the form of pictures, film-strips, transparencies and models may afford certain students a chance to display talents other than those typically called for by standard testing procedures.
2. Additionally, it is recommended that pictures be used when the material that is being presented is highly visual in nature and when it confronts the student with a degree of unfamiliarity. Although the characteristic of unfamiliarity may not be an essential criterion for the selection of the visual mode of presentation, it should be considered when educational strategies are formulated. Pictures may be quite useful when familiar subject matter is being presented, but they may be extremely important when unfamiliar subject matter is being presented.
3. When utilizing visual materials that contain specific cues that are to be identified and recalled, the visuals should have appropriate printed verbal labels incorporated into the design. A congruent verbal description should also be used in conjunction with the visual, but it should be paced so that it does not interfere with the subject's comprehension of the material which enters the perceptual system through the visual modality. Pacing should also be practiced with the presentation rate of the visuals so that interference with the verbal inputs does not occur.
4. The compressed or simple outline visual should be used where economy of means does not interfere with the retention of the desired information. The compressed visual should not be used where the visual material is partially or entirely new to

the subject. If the subsequent identification of a specific attribute of the referent is to be required of the subject, then this attribute should be represented in the visual surrogate for maximum retention. The compressed visual may be useful when it serves as a surrogate for a referent which is relatively familiar to the subject.

5. For maximum delayed recall it is recommended that visual or visual/verbal presentations be utilized in preference to the verbal only presentation when the subject matter involves highly visual referents. The decline in the learning curve is much greater over time for the verbal only presentation of highly visual materials than it is for either the visual or the visual/verbal presentations.
6. High fidelity (realistic) visuals should be used with all student groups regardless of the intelligence quotient differential of the members of the group. It is recommended that if such realistic visuals are employed they should not be overburdened with irrelevant cues, although a certain number of these cues can be tolerated by the subjects without apparent ill effect.
7. It is suggested that the cartoon treatment can effectively be employed in certain circumstances. It may be used as a method of presenting information to all I.Q. groups; however, it may be most effective with the middle group. It is recommended that further research be conducted in order to determine precisely what the role of the cartoon is in the transmission of visual information.

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